National Park Service Special Images

The following images have been extracted from the IMPROVE Slide Spectrum CDs. They represent the cleanest and the haziest clear sky, non-weather, images found in the IMPROVE 35mm slide data base. For each image, the extinction coefficient was estimated from slide contrast measurements. Then using the average species concentrations of the 20% lowest and highest fine mass days, the yearly average f(rh) from EPA's HazeCalc program, and the following procedure, the estimated Reconstructed $PM_{2.5}$ and PM_{10} aerosol concentrations were calculated:

$$b_{ext} = 3.0\ f(rh)[Sulfate] + 3.0\ f(rh)[Nitrate] + 4.0[OMC] + 10.0[LAC] + 1.0[Soil] + 0.6[CM] + b_{RAY} \quad (1)$$

$$\text{Reconstructed Fine Mass} = RCFM = [Sulfate] + [Nitrate] + [OMC] + [LAC] + [Soil] \quad (2)$$

$$\text{Species Mass Fraction} = FracSpecies = [Species] / RCFM \quad (3)$$

Then rearranging and dividing both sides of equation 1 by RCFM

$$\frac{\{b_{ext} - b_{RAY}\}}{RCFM} = \frac{3.0\ f(rh)[Sulfate]}{RCFM} + \frac{3.0\ f(rh)[Nitrate]}{RCFM} + \frac{4.0[OMC]}{RCFM} + \frac{10.0[LAC]}{RCFM} + \frac{1.0[Soil]}{RCFM} + \frac{0.6[CM]}{RCFM} \quad (4)$$

Then for any estimated b_{ext} and specific Species Mass Fractions, the corresponding RCFM can be calculated as:

$$PM_{2.5} = RCFM = \{b_{ext} - b_{RAY}\} / \{\ 3.0\ f(rh)\ FracSulfate + 3.0\ f(rh)\ FracNitrate + 4.0\ FracOMC + 10.0\ FracLAC + 1.0\ FracSoil + 0.6\ FracCM\ \} \quad (5)$$

$$PM_{10} = RCFM + RCFM*FracCM \quad (6)$$

Bryce Canyon National Park: Estimated b_{ext} = 11 Mm^{-1}, $PM_{2.5}$ = 0.2 $\mu g/m^3$, PM_{10} = 0.4 $\mu g/m^3$

Bryce Canyon National Park: Estimated b_{ext} = 78 Mm^{-1}, $PM_{2.5}$ = 14.2 $\mu g/m^3$, PM_{10} = 30.2 $\mu g/m^3$

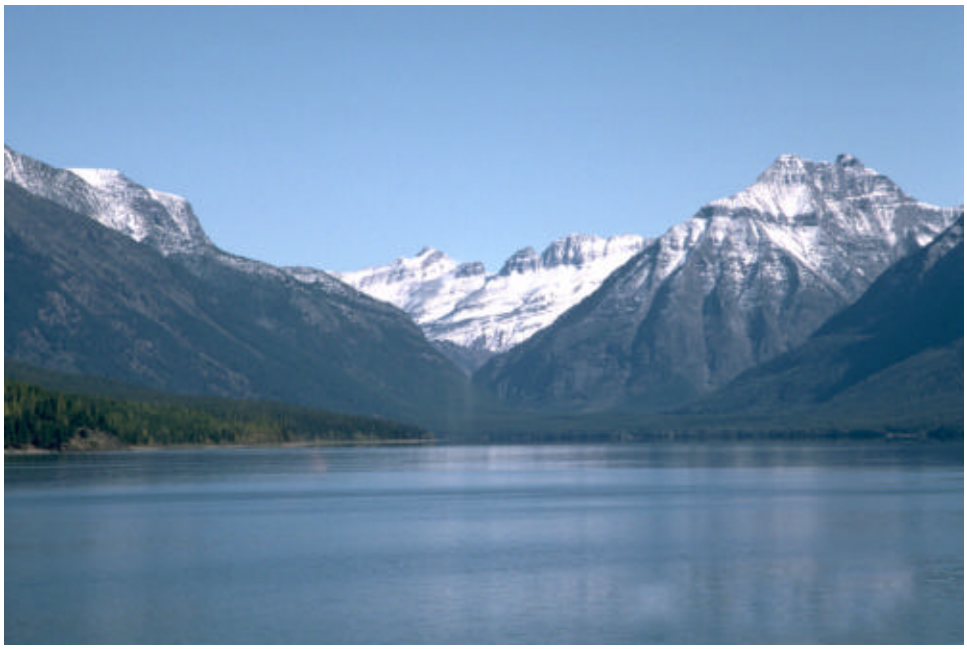
Canyonlands National Park: Estimated b_{ext} = 12 Mm^{-1}, $PM_{2.5}$ = 0.3 $\mu g/m^3$, PM_{10} = 1.1 $\mu g/m^3$

Canyonlands National Park: Estimated b_{ext} = 98 Mm^{-1}, $PM_{2.5}$ = 16.7 $\mu g/m^3$, PM_{10} = 45.8 $\mu g/m^3$

Crater Lake National Park: Estimated b_{ext} = 12 Mm^{-1}, $PM_{2.5}$ = 0.3 $\mu g/m^3$, PM_{10} = 0.7 $\mu g/m^3$

Crater Lake National Park: Estimated b_{ext} = 391 Mm^{-1}, $PM_{2.5}$ = 62.7 $\mu g/m^3$, PM_{10} = 135.2 $\mu g/m^3$

Glacier National Park: Estimated b_{ext} = 11 Mm^{-1}, $PM_{2.5}$ = 0.2 $\mu g/m^3$, PM_{10} = 0.4 $\mu g/m^3$



Glacier National Park: Estimated b_{ext} = 206 Mm^{-1}, $PM_{2.5}$ = 34.0 $\mu g/m^3$, PM_{10} = 71.1 $\mu g/m^3$

Grand Canyon National Park: Estimated b_{ext} = 11 Mm^{-1}, $PM_{2.5}$ = 0.2 $\mu g/m^3$, PM_{10} = 0.6 $\mu g/m^3$

Grand Canyon National Park: Estimated b_{ext} = 195 Mm^{-1}, $PM_{2.5}$ = 37.3 $\mu g/m^3$, PM_{10} = 93.1 $\mu g/m^3$

Great Basin National Park: Estimated b_{ext} = 11 Mm^{-1}, $PM_{2.5}$ = 0.2 $\mu g/m^3$, PM_{10} = 0.5 $\mu g/m^3$

Great Basin National Park: Estimated b_{ext} = 98 Mm^{-1}, $PM_{2.5}$ = 18.7 $\mu g/m^3$, PM_{10} = 40.8 $\mu g/m^3$

Mesa Verde National Park: Estimated b_{ext} = 11 Mm^{-1}, $PM_{2.5}$ = 0.2 $\mu g/m^3$, PM_{10} = 0.5 $\mu g/m^3$

Mesa Verde National Park: Estimated b_{ext} = 98 Mm^{-1}, $PM_{2.5}$ = 18.4 $\mu g/m^3$, PM_{10} = 42.6 $\mu g/m^3$

Mount Rainier National Park: Estimated b_{ext} = 15 Mm^{-1}, $PM_{2.5}$ = 0.7 $\mu g/m^3$, PM_{10} = 2.1 $\mu g/m^3$

Mount Rainier National Park: Estimated b_{ext} = 391 Mm^{-1}, $PM_{2.5}$ = 54.0 $\mu g/m^3$, PM_{10} = 82.2 $\mu g/m^3$

Point Reyes National Park: Estimated b_{ext} = 12 Mm^{-1}, $PM_{2.5}$ = 0.1 $\mu g/m^3$, PM_{10} = 0.5 $\mu g/m^3$

Point Reyes National Park: Estimated b_{ext} = 196 Mm^{-1}, $PM_{2.5}$ = 23.3 $\mu g/m^3$, PM_{10} = 62.3 $\mu g/m^3$

Rocky Mt. National Park: Estimated b_{ext} = 13 Mm^{-1}, $PM_{2.5}$ = 0.5 $\mu g/m^3$, PM_{10} = 1.7 $\mu g/m^3$

Rocky Mt. National Park: Estimated b_{ext} = 196 Mm^{-1}, $PM_{2.5}$ = 36.6 $\mu g/m^3$, PM_{10} = 76.6 $\mu g/m^3$

Shenandoah National Park: Estimated b_{ext} = 13 Mm^{-1}, $PM_{2.5}$ = 0.3 $\mu g/m^3$, PM_{10} = 0.5 $\mu g/m^3$

Shenandoah National Park: Estimated b_{ext} = 531 Mm^{-1}, $PM_{2.5}$ = 65.4 $\mu g/m^3$, PM_{10} = 86.4 $\mu g/m^3$

Weminuche Wilderness: Estimated b_{ext} = 11 Mm^{-1}, $PM_{2.5}$ = 0.2 $\mu g/m^3$, PM_{10} = 0.6 $\mu g/m^3$

Weminuche Wilderness: Estimated b_{ext} = 130 Mm^{-1}, $PM_{2.5}$ = 23.6 $\mu g/m^3$, PM_{10} = 53.2 $\mu g/m^3$

Yellowstone National Park: Estimated b_{ext} = 15 Mm^{-1}, $PM_{2.5}$ = 0.8 $\mu g/m^3$, PM_{10} = 2.3 $\mu g/m^3$

Yellowstone National Park: Estimated b_{ext} = 196 Mm^{-1}, $PM_{2.5}$ = 36.8 $\mu g/m^3$, PM_{10} = 104.0 $\mu g/m^3$

Yosemite National Park: Estimated b_{ext} = 12 Mm^{-1}, $PM_{2.5}$ = 0.3 $\mu g/m^3$, PM_{10} = 1.1 $\mu g/m^3$

Yosemite National Park: Estimated b_{ext} = 245 Mm^{-1}, $PM_{2.5}$ = 43.9 $\mu g/m^3$, PM_{10} = 83.4 $\mu g/m^3$